METHODS OF STIMULATING WATER SENSITIVE COAL BED METHANE SEAMS

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention relates to methods of stimulating water sensitive coal bed methane seams that are under saturated with low pressure methane gas.

2. DESCRIPTION OF THE PRIOR ART

[0002] The production of methane from subterranean coal beds by way of wells drilled into the coal beds has been practiced for many years. Generally, the coal beds contain absorbed hydrocarbon gases consisting primarily of methane. The coal beds usually contain water which when produced causes pressure to be reduced and the methane and other gases to be desorbed from the coal and produced along with the water.

[0003] In some areas containing a plurality of thin coal bed seams, the methane gas in the seams has a low pressure and the seams are under saturated. A typical such field has from about 10 to about 40 thin coal bed seams in a 1,500 foot vertical well bore. These coal bed seams do not contain water and when the coal in the seam is exposed to water, it becomes plugged and the methane gas will not flow through the coal. As a result, the coal bed seams have been fractured with nitrogen gas utilizing coiled tubing and packers above and below the seam being fractured. The nitrogen gas rates utilized in the fracturing process have generally been about 5,400 standard cubic feet of nitrogen per foot of coal thickness. In order to provide the high rate of nitrogen gas, multiple high

pressure pumper trucks are required making the operation very complex and expensive to carry out.

[0004] Thus, there is a need for simpler and less expensive methods of forming flow passages in thin coal bed seams containing methane.

SUMMARY OF THE INVENTION

[0005] The present invention provides methods of stimulating water sensitive coal bed seams that are under saturated with low pressure methane gas which meet the above described need and overcome the deficiencies of the prior art.

[0006] A method of this invention for stimulating a water sensitive coal bed seam containing methane gas penetrated by a well bore to enhance the production of methane gas therefrom comprises the following steps. The coal bed seam is contacted and heated with hot nitrogen gas so that the coal bed in the seam shrinks and forms methane gas flow passages therein. Thereafter, the methane gas is produced through the flow passages.

[0007] Another method of the present invention for stimulating a water sensitive coal bed seam penetrated by a well bore that is under saturated with low pressure methane gas comprises the following steps. A source of nitrogen gas is provided on the surface and the nitrogen gas is pumped at a relatively low rate by way of coiled tubing and a heater disposed in the well bore into the coal bed seam. The nitrogen gas is heated by the heater to a temperature in the range of from about the in situ ambient temperature to about 350°F so that the nitrogen gas heats the coal bed and causes it to shrink and form enlarged methane gas flow passages therein. Thereafter, the methane gas is produced from the coal bed by way of the flow passages therein.

[0008] The objects, features and advantages of the present invention will be readily apparent to those skilled in the art upon a reading of the description of preferred embodiments which follows.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0009] As mentioned, water sensitive coal bed seams containing under saturated low pressure methane gas have heretofore been difficult and expensive to fracture whereby the methane gas can be produced. The present invention provides methods of stimulating the thin water sensitive coal bed seams which are substantially less expensive than the prior art methods and allow the coal bed seam methane gas to be readily produced.

[0010] The methods of the present invention for stimulating a water sensitive coal bed seam containing under saturated low pressure methane gas penetrated by a well bore basically comprises the following steps. The coal bed seam is contacted and heated with hot nitrogen gas so that the coal bed in the seam shrinks and forms methane gas flow passages therein. Thereafter, the methane gas is produced through the flow passages.

[0011] The hot nitrogen gas is pumped into a coal bed seam at a low rate and pressure sufficient to heat and shrink the coal bed thereby forming methane flow passages therein. The particular flow rate and pressure of the nitrogen gas required is such that the coal bed seam is contacted by the hot nitrogen gas and heated over a desired length in a desired period of time.

[0012] The nitrogen gas is pumped from the surface into the coal bed seam and the nitrogen gas is heated in the well bore by a heater disposed therein to a temperature in

the range of from about the in situ ambient temperature to about 350°F, preferably about 212°F.

[0013] A variety of heaters suitable for being positioned within the well bore can be utilized including, but not limited to, electric heaters or electric or friction heat exchangers. Generally, the well bore includes casing and perforations extending into the coal bed seam and the heater is positioned in the well bore adjacent to or near the coal bed seam. The nitrogen gas is preferably pumped through coiled tubing disposed in the well bore connected to the heater and packers are utilized to isolate the coal bed seam being treated.

[0014] A more detailed method of this invention for stimulating a water sensitive coal bed seam that is under saturated with low pressure methane gas comprises the following steps. A source of nitrogen gas is provided on the surface and the nitrogen gas is pumped at a relatively low rate by way of coiled tubing and a heater disposed in the well bore into the coal bed seam. The nitrogen gas is heated in the heater to a temperature in the range of from about the in situ ambient temperature to about 350°F, preferably about 212°F so that the nitrogen gas heats the coal bed and causes it to shrink and form enlarged methane gas flow passages therein. Thereafter, the methane gas in the coal bed seam is produced by way of the flow passages.

[0015] In a well bore that contains a plurality of spaced apart thin coal bed seams, each coal bed seam is separately stimulated in accordance with this invention whereby methane gas is readily produced from the coal bed seams. The well bore is preferably cased and perforations extend into each of the coal bed seams. As each coal bed seam is

stimulated, the packers, the coiled tubing and the heater are positioned in the well bore adjacent to or near the next coal bed seam to be stimulated.

[0016] A preferred method of this invention for stimulating a water sensitive coal bed seam containing methane gas penetrated by a well bore to enhance the production of methane gas therefrom comprises the steps of:

(a) contacting and heating the coal bed seam with hot nitrogen gas so that the coal bed in the seam shrinks and forms methane gas flow passages therein; and

(b) producing the methane gas through the flow passages.

[0017] Another preferred method of this invention for stimulating a water sensitive coal seam penetrated by a well bore that is under saturated with low pressure methane gas comprises the steps of:

(a) providing a source of nitrogen gas on the surface and pumping the nitrogen gas at a relatively low rate by way of coiled tubing and a heater disposed in the well bore into the coal bed seam;

(b) heating the nitrogen gas by the heater to a temperature in the range of from about the in situ ambient temperature to about 350°F so that the nitrogen gas heats the coal bed and causes it to shrink and form enlarged methane gas flow passages therein; and

(c) producing methane gas from the coal bed by way of the flow passages.

[0018] Thus, the present invention is well adapted to attain the ends and advantages mentioned as well as those which are inherent therein. While numerous changes may be made by those skilled in the art, such changes are encompassed within the spirit of this invention as defined by the appended claims.